

## Experiment believed to detect evidence of dark matter

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By Carolyn Y. Johnson  
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A space-based experiment nearly two decades in the making — led by Nobel laureate and MIT physicist Samuel C.C. Ting — has detected tantalizing, though preliminary, evidence of a signal that might be caused by dark matter, the long-sought, mysterious substance that makes up about a quarter of the universe.

The announcement Wednesday in Switzerland, inconclusive though it is, was a major victory for Ting, who many credit with having the sheer force of will to push the Alpha Magnetic Spectrometer project forward through uncertain times. The 7.5-ton, \$2 billion instrument was carried to the international space station in 2011 aboard the last flight of space shuttle Endeavour.



Speaking at a press conference, Ting said he was pleased with the initial result and certain that the experiment would definitively answer the question of whether the signal was caused by the collision of dark matter particles. The signal could also be generated by a less interesting source — spinning stars called pulsars.

“What we have shown today only represents less than 10 percent of the data, and so with longer data collection times . . . I think with AMS, there’s no question we are going to solve this problem,” said Ting, who led a collaboration of hundreds of scientists and engineers from 16 countries. Asked how much longer data would need to be collected, he said, “we do not know, because it really doesn’t depend on us; it depends on nature.”

For years, scientists have known that dark matter is abundant in the universe. Although it does not interact with light and has never been directly detected, scientists know from gravitational measurements that it makes up about a quarter of the universe. Understanding dark matter and detecting it directly is one of the major challenges in physics.

The Alpha Magnetic Spectrometer provided one possible way to detect dark matter, based on a theory that predicts that when particles of dark matter smash into and annihilate one another, the collision generates particles called positrons. Positrons are the reverse of ordinary electrons, antiparticles with the same mass, but carrying a positive charge.

The theory predicts the collision leaves a trail, which would be seen as an excess of positrons that seem to emanate from all around, not from any particular direction. Theories also predict that at greater energy levels, the excess of positrons should rise and then drop off rapidly.

The observations reported by Ting and collaborators fulfilled part of those requirements, he reported at a scientific seminar at CERN in Switzerland and at a NASA press conference. The instrument picked up an excess of positrons that increased at higher energies.

Those excess positrons did not come from any particular direction. And there were signs that the excess of positrons might be leveling off, a signal consistent with positrons created by dark matter, but still not enough to rule out that they were generated by pulsars. Those results will be published in the journal [Physical Review Letters](#).

“The results of AMS can be read as the first episode of a thriller,” Piergiorgio Picozza, an Italian physicist who works on a smaller, rival experiment, called PAMELA, wrote in an e-mail.

“One can see the clues, a hint of flatness that could herald the descent that we all desire,” wrote Picozza.

Over its first year and a half of operation, the Alpha Magnetic Spectrometer registered 25 billion cosmic rays, high-energy particles that are detected by the instrument. The space instrument has a lifetime of 10 years, however, and Ting and others expressed confidence that further data will allow them to draw a conclusion.

“What is impressive at this point is not the science result, but rather their putting a large complex major instrument in space that can make such precise measurements,” Barry Barish, a physicist at the California Institute of Technology, wrote in an e-mail.

“How important is the science they report? That remains to be seen. . . . The explanation, when it comes, could be a major discovery like dark matter, or it may be due to some less exciting astrophysical phenomena. Time will tell.”

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<http://www.bostonglobe.com/news/science/2013/04/03/mit-led-space-experiment-yields-preliminary-evidence-dark-matter/KJmx5gaCwYcpsHNWJ9Mf5O/story.html>